Developing and Evaluating a Mobile App for an Online Course: A Usability Study

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Abstract: The Pew Research Center reports that 10% of Americans rely heavily on smartphones for high-speed internet access at home. This trend is particularly strong among low-income households (Smith, 2015). A digital divide manifested by varying broadband access may exist among online students. For this reason, online course materials should be easily accessible on mobile devices. The author developed a mobile app for her online management information systems (MIS) course, BUSA 345. This study looked into four factors in the usability of the "BUSA 345 app": design, navigation, ease of use, and perceived usefulness.

Two rounds of the study were conducted. Seven students with an average age of 26.7 years participated. The participants used their smartphones to perform tasks based on the app. A pre-test survey revealed that participants had 66 apps on average installed on their smartphones, and they scored high in tech efficacy. However, they had only three apps for school on average. The post-test results indicated that the students rated the ease of use and usefulness of the "BUSA 345 app" highly on both iOS and Android platforms. All participants strongly agreed that the app was useful for learning and they would use the app if it were available. This usability study shows that the "BUSA 345 app" was embraced by the student participants, who looked forward to being able to access course materials on the go.

Introduction

This study was motivated by the assumption that a *digital divide* manifested in broadband access exists among students at the college where I teach. The Pew Research Center (2015) reports that 64% of American adults now own a smartphone, while 10% of Americans rely heavily on a smartphone for high-speed internet access at home. Among 18–29 year-olds, 15% depend on a smartphone for online access. This trend is especially strong among low-income households with relatively few alternatives for internet access (Smith, 2015). At the same time, online courses have made impressive inroads in mainstream higher education. For instance, Arizona State University (ASU) (2015) now

offers undergraduate online degrees in 49 subjects including a BS in Information Technology. Allen and Seaman reported in 2014 that in US higher education, the number of students taking at least one online course had reached 7.1 million, and enrollment in online courses continued to grow far faster than overall enrollment (Allen & Seaman, 2014).

At the regional college where this usability study was conducted, a third of all courses are offered online, and they are routinely the first to reach enrollment capacity. It is evident that online courses are popular among this student body. Additionally, 88% of students at the college are from minority ethnic groups, and 27% are from the historically underserved indigenous group of the region. The majority of students depend on loans, scholarships, and grants to pay their tuition. The findings of the Pew Research Center report suggest a high likelihood that many of these students only have Internet access at home via a mobile device. Considering the unique background of the student population at this regional college, along with the likelihood that mobile devices may be their main mode of accessing online course materials, investigating the feasibility of a mobile-enabled online course seemed a worthwhile undertaking.

In this context, I developed a mobile app for an online management information systems (MIS) course and a website called "App for Online." This website introduced several functions of smartphones that could be conducive to better access to course materials, but that students may not be using or aware of. Some examples of such functions are pinning a homepage, downloading a PDF file to iBook, and voice recording. The mobile app was also intended to work as an organization tool for the multiple platforms this online course uses and was expected to facilitate on-the-go access to the material for busy students with various obligations in their life. This usability study looked into the design, navigation, ease of use, and usefulness of the mobile app. In addition, it examines the effectiveness of the "App for Online" website that introduced how to use the mobile app for the course, and the compatibility and integration of the existing course website (busa345.org) (Figure 1) and the course's Google+ community discussion site. The newly created mobile app aimed to integrate multiple platforms: the course website; the college's official course management system, which is called Laulima; the "App for Online" mobile learning instruction site; and Google's native apps (*Google+* and *Hangouts*).

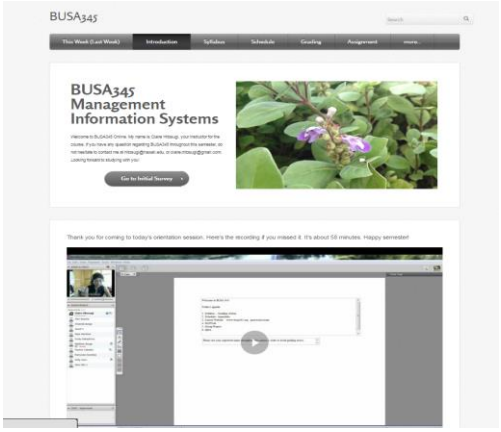


Figure 1. BUSA 345 MIS Course Website Desktop Monitor View

Literature Review

Sharples, Taylor and Vavoula (2007) point out the characteristics of mobile learning as: 1. Learners are continuously on the move, 2. Learning occurs outside classrooms or offices, and 3. Learning is community-based and should take into account the ubiquitous use of personal and shared technology. Learning and technology converge under these principles of mobile learning (Table 1). New learning is more personal, situated, ubiquitous, and continues anywhere learners go.

Table 1. Convergence Between Learning And Technology (Sharples et al., 2007)

New Learning	New Technology
Personalized	Personal
Situated	Mobile
Collaborative	Networked
Ubiquitous	Ubiquitous
Lifelong	Durable

Various scholars have also pointed out that improving the sense of community among learners has a positive impact on students' learning experiences, enhancing their motivation and preventing course dropouts. Creating a sense of community in our online classrooms has been a recurring theme for the last two decades in the online teaching and learning literature (Drouin, 2008; McInnerney & Roberts, 2004; Rovai, 2002). The online community of inquiry (COI) model describes three elements – social presence, cognitive presence and teaching presence as critical in promoting a sense of a learning community (Garrison, Anderson, & Archer, 1999). Online learning takes place outside of the classroom where students log on to the course website and engage with materials over the Internet. Mobile learning should enhance the principles of COI in online learning and should promote students' overall learning experiences.

Mayer delineates various principles of multimedia learning (2009) that are relevant to developing e-learning materials, whether it is creating a website or optimizing the content for a smartphone. In particular, the principles concern developing the materials for an online course: *coherence principle* – people learn better when extraneous material is excluded; *spatial and temporal contiguity principles* – people learn better when corresponding words and pictures are presented next to each other simultaneously; *segmenting principle* – people learn better when a message is presented in user-paced segments.

Furthermore, usability professionals emphasize "design for context", that is, good design depends on context. Context is a combination of factors about the situation in which the product will be used. "When a product fits well into its context, it is easy to use (http://www.designforcontext.com/about-us)." As depicted in Figure 2, I needed to keep in mind the five contexts in developing an app for online students; user characteristics and experiences, tasks and goals, user environment and location, technology capabilities

and limitations, and organization and product goals. The last context, organization and product goals, indicates in this study, the university and students' academic performances.

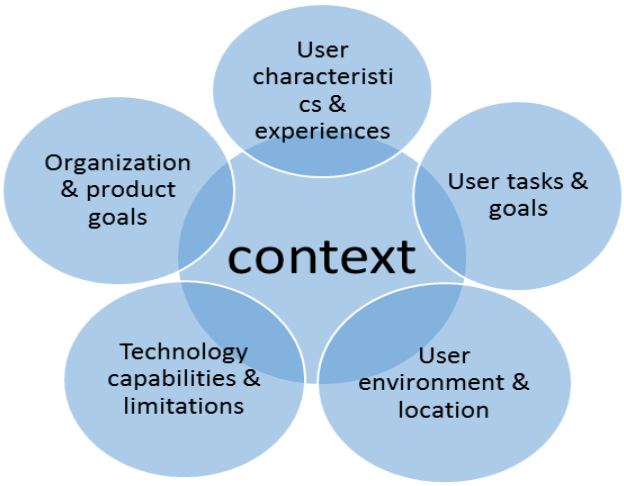


Figure 2. What Does "Design For Context" Mean? (http://www.designforcontext.com/about-us)

Nielsen, a well-known usability consultant, defines usability as a quality attribute that assess how easy user interfaces are to use as defined by five quality components (2003):

1. Learnability: How easy is it for users to accomplish basic tasks the first time they encounter the design?
2. Efficiency: Once users have learned the design, how quickly can they perform tasks?
3. Memorability: When users return to the design after a period of not using it, how easily can they reestablish proficiency?
4. Errors: How many errors do users make, how severe are these errors, and how easily can they recover from the errors?
5. Satisfaction: How pleasant is it to use the design?

Nielsen further compared several usability factors (1994), and described the top heuristics to explain usability problems (Table 2). He points out that the five factors – seeing/pointing vs. remembering/typing, consistency, timely feedback, and salient repertoire of available actions – are top heuristics to explain serious usability problems.

In developing a mobile app, we need to keep in mind both of these e-learning principles in digital environment and usability principles. The app developed should be viable for users in order to assure an easy-to-use user experience. For this, we need to conduct a usability study. Usability is a quality attribute that assesses how easy user interfaces are to use. It also refers to methods of improving ease-of-use during the design process (Nielsen, 2003). This usability study aimed to capture these theories in the context of mobile learning and provide busy online students with a smartphone app for an improved e-learning experience.

Table 2. Top Heuristics to Explain All the Usability Problems (Nielsen, 1994 p.154)

1.	Consistency: same thing, same way
2.	Speak the user's language
3.	Feedback: show receipt of user's input
4.	Seeing/pointing vs. remembering/typing
5.	Aesthetic integrity, keep design simple
6.	Shortcuts and accelerators
7.	Real-world conventions
8.	Help error recognition/recovery
9.	Forgiveness; reversible computer actions
10.	Salient repertoire of available actions

Project Design

The purpose of this usability project was to develop and evaluate the design, navigation, ease of use, and perceived usefulness of a mobile app for an existing online course at the University of Hawai'i–West O'ahu. The goal is to provide a mobile app that will allow students better access to online course materials on a mobile device, and thus to facilitate and support students' e-learning. The project's first task was to build a mobile app for the BUSA 345 MIS online course that I regularly teach, and then to develop an instrument to measure the app's usability in four areas (design, navigation, ease of use, and perceived usefulness). The study was conducted in two rounds. Improvements were made after the first round and implemented in the second round. Finally, the data were collected and analyzed.

Mobile app development. A mobile application for the MIS course was developed on AppMkr (https://www.infinitemonkeys.mobi/machine), a HTML5 code-free app platform. AppMkr requires no knowledge of coding, and allows the user to create and host an app free of charge or for a $9 per month subscription. AppMkr was founded in 2010 and was later acquired by another mobile app developer, Infinite Monkey. Their platforms were merged in 2013. This is a relatively new mobile app machine on the market, but it is quickly expanding its market share. However, perhaps due to its short time on the market (as the tech industry is known to roll out products that are 80% complete and follow up with updates), I experienced some technical glitches with the AppMkr platform.

Apps built on the AppMkr platform should function across platforms on iOS, Android, and Windows operating systems. Yet some features did not work smoothly on iOS. For example, the telephone call feature initially did not work at all. I reported the issue to AppMkr tech support, and the problem was resolved a week later. I had to resolve some other minor glitches with the AppMkr tech support team. In the end, I came up with an app integrating seven functions: the links to (1) the BUSA 345 course website, (2) the course schedule, (3) Laulima, (4) the e-textbook site, *Flatworld*, (5) Pearson's tech hands-on site, (6) the app for an online tutorial website, and (7) the call-your-instructor

function (Figure 3). The URL of the file app is http://theapp.mobi/busa345app. The graphics depicting the interfaces of the links to the BUSA 345 website, the schedule, Google+ and Hangout, can be found in Appendix A. The students only needed to tap an icon to jump to the pertinent site. This app therefore worked as an organization tool for the course that employs various platforms. In past semesters, I received comments from students that using various platforms for this course was confusing. This app was designed to solve this problem.

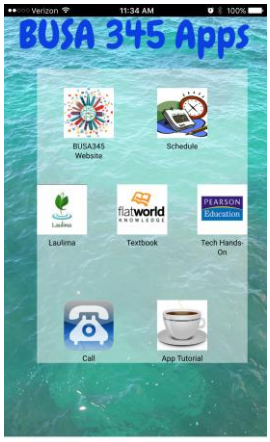


Figure 3. The BUSA 345 Mobile App Interfaces

Task website & survey instrument development. Having developed the BUSA 345 app, I needed to come up with a usability research method in order to evaluate the effectiveness of my app. This was my first usability study, and I did not have much knowledge on usability methodology. I conducted a think-aloud method that has been commonly employed in usability studies, where participants verbalized mental steps as they completed tasks. For this, I needed to develop several tasks for participants to carry out with their mobile device and questions to explore what they thought of the app after they finished these tasks.

I developed the "App for Online" website (http://appforonline.weebly.com/) to provide students with instructions on how to use the mobile app to add functions to their mobile device. The instructions, which needed to be useful and convenient for the online students, were extensively revised after the first round of the usability study (Appendix B). I then developed a pre-test survey, and a post-test survey. The pre-test survey questions mainly focused on the participants' demographic information, smartphone usage, and technology efficacy (Appendix C). The post-test survey questions asked the participants about their experiences in the areas of design, navigation, ease of use, and usefulness while they completed the tasks using the app. It also included four open-ended questions where participants could freely write their comments (Appendix D). Prior to conducting the study, I submitted all the materials to the campus Institutional Review Board (IRB) for research with human subjects, and I received IRB approval for exempt status for this study.

Methods

Participants. I recruited volunteers from the BUSA 345 MIS online course I taught in Spring 2016. The two participation criteria were being a student in this online course and owning a smartphone. Three students (1 female, 2 males) participated in Round 1, and another four students (3 females, 1 male) participated in Round 2 of the study (Table 3). They were all undergraduates seeking bachelor's degrees, and their class standing was junior or senior. Many were non-traditional students who worked fulltime and/or had families. Their average age of participants was 26.7 years (20–43 years). The study was conducted on the participants' own smartphones. Having the students use their own mobile devices seemed to be most appropriate, as I aimed to facilitate learning through the use of students' mobile devices. I informed the students prior to conducting the study that participation (or non-participation or withdrawal) would not have any impact on course grades, our teacher/student relationship, or their standing with the institution.

Table 3. Rounds 1 & 2: Participants

ID#	Gender	Age	Ethnicity	Class Standing	Type of Phone iOS/Android Brand & Model
First Round (R1)					
R1. 01	F	23	Mixed Asian	Junior	iPhone 6 plus
R1. 02	M	23	Filipino	Senior	Android Samsung Galaxy S6
R1. 03	M	20	Afro-American	Junior	iPhone 5s
Second Round (R2)					
R2. 01	F	23	Filipino	Senior	Android Samsung Galaxy Core Prime
R2. 02	M	43	Afro-American	Senior	Android LG
R2. 03	F	26	Mixed Asian	Senior	iPhone 6
R2. 04	F	29	Mixed Asian	Senior	iPhone 6
Average age: 26.7 years					

Instruments. The Surveymonkey website was used to collect data from pre- and post-test surveys (https://www.surveymonkey.com/). During the study, the participants in the first round were asked to complete five specific tasks; those in the second round were asked to complete seven tasks. The participants took the post-test survey after they completed the tasks using their own smartphones. The post-test survey asked questions using a 5-point Likert scale to measure design, ease of use, navigation, and perceived usefulness of the mobile app just used. The results of the post-test surveys from the two rounds were compared to see the effects of the changes implemented after the first round.

Data collection. Each participant completed the study individually in a quiet room on campus. Having understood and signed the consent form, participants took the short pre-survey. Then, the investigator instructed the participant to complete the simple cognitive walkthrough tasks on their smartphone following the directions on the "App for Online" website. The participants were instructed to talk aloud, saying whatever came to mind, while completing the tasks. However, their voices and finger movements on the device were not successfully recorded. Therefore, the cognitive walkthrough was not included in

the data analysis. I sat at the same table while the subjects were engaged in these tasks. Each subject was briefly interviewed afterwards.

Results

Pre-test survey results. The pre-test survey looked into participants' demographics and characteristics, and how they use their smartphones on a daily basis. The results revealed that the students were tech savvy. Table 4 shows the pre-test results. Even though only one participant had programming experience, they all felt they were good at technology and that they learned new technology with ease. The students reported using their smartphones throughout the day. They felt comfortable using apps. Out of seven participants, four responded that they regularly used more than seven apps, and three responded that they regularly used four to six apps. On average, they had sixty-six apps installed on their phones.

Table 4. Results of the Pre-test Survey Questions

Question	Results
How often do you use your smart phone a day?	4.86*
How comfortable are you with using mobile apps?	4.71*
How many apps do you have on your smart phone now?	66
How many apps do you regularly use on your phone?	More than 7 apps (4) 4–6 apps (3)
How many of the apps that you have on your smartphone can be considered "for school/college"?	Zero app (2) 1–3 apps (3) 4–6 apps (2)
Do you regularly access online course content on your smart phone?	4.00*
Do you consider yourself good at technology in general?	4.14*
Do you usually learn new technology with ease?	4.29*

* denotes the mean of the responses on the 5-point Likert scale (with 5 the highest score, meaning "very often," "very comfortable," or "strongly agree," and 1 the lowest score, meaning "rarely," "uncomfortable," or "strongly disagree").

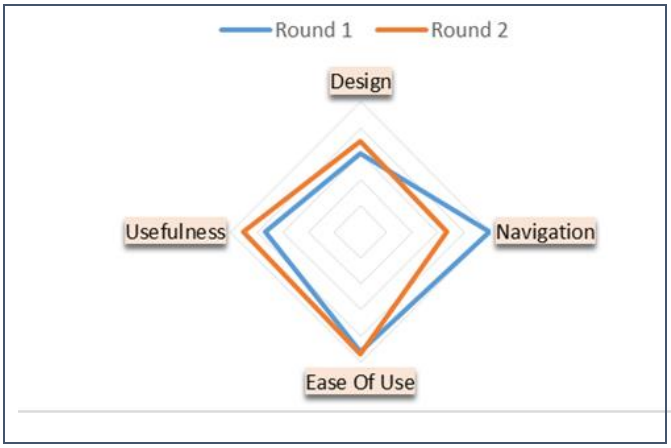
However, in responding to the question, "How many of the apps that you have on your smartphone can be considered for school/college?" two responded zero, three responded one through three, and another two responded four through six apps. In other words, 9% or fewer of their apps were used for school. The participants mainly used their devices for social networking, getting in touch with friends, keeping up with news, shopping, couponing, and getting directions. The pre-test survey questions are listed in Appendix C.

Post-test survey results. The post-test survey asked the participants about their experience with the BUSA 345 mobile app. Having completed the five (Round 1) or seven (Round 2) steps of the tasks by following the directions on the "App for Online" website, the participants responded to the post-test survey questions and described their experiences in response to open questions. The post-test survey questions are listed in Appendix D.

The post-test survey looked into the four factors of the usability of the BUSA 345 app: design, navigation, ease of use, and perceived usefulness. Each factor was addressed by three to five questions. The design questions asked about the clarity, ease of reading, and image quality of the app and the organization of the site. The navigation questions addressed ease of navigation, the number of buttons and pop-ups, and labels for buttons or pages. The ease of use questions asked whether the app was user-friendly, whether it was easy to use and possible to use without instructions, and about the appeal of the presentation. The perceived usefulness questions asked if they would use the app, if they thought it was useful for learning the subject, and whether they thought it would enable them to access online course materials anytime, anywhere, when they were on the go.

The results of Round 1 (n = 3) showed overall good usability, with all participants' ratings at higher than 4.60 (out of 5) in all four categories (Figure 4). The participants checked "strongly agree" for all questions regarding the navigation factor (Table 5). The mean rating for ease of use was 4.92 and for usefulness was 4.73. All three participants – two iOS (iPhone) users and one Android user – agreed that the app was easy to navigate and easy to use. A couple of participants mentioned that the instructions on the "App for Online" website were not clear at times; they specified that it was not the app itself but the instructions that they were following in order to complete the tasks that were sometimes confusing and could be improved. The Android user, R1.02, seemed to have more problems related to the instructions.

After the first couple of participants had completed the study, it became clear that the app was straightforward but the instructions on the "App for Online Course" website needed to be changed. This website intended to teach the participants how to use their mobile device for their online course, and it introduced several key tools useful for accessing the course materials and their teamwork project. After Round 1, I revised the task instructions and increased the number of tasks from five to seven. Thanks to the Android participant, R1.02, I was able to include Android mobile screen shots in the Round 2 task instructions. The results of the Round 2 study demonstrated higher rating over Round 1 – the design (4.60, 4.70), ease of use (4.92, 4.94), and usefulness factors (4.73, 4.90). However, the score of the navigation factor went down, from 5.00 to 4.67 (Figures 4 & Table 5).



Rounds 1 & 2 Results by Factors		
	Factor	**Mean**
Round 1 (n = 3)	Design	4.60
	Navigation	5.00
	Ease of Use	4.92
	Usefulness	4.73
Round 2 (n = 4)	Design	4.70
	Navigation	4.67
	Ease of Use	4.94
	Usefulness	4.90

Figure 4. Rounds 1 & 2 Post-test Survey Results by Factors

Table 5. Overall Results of Post-test Survey Rounds 1 & 2

Questions	Round 1 (n = 3)	Round 2 (n = 4)	Questions	Round 1 (n = 3)	Round 2 (n = 4)
Design			**Ease of Use**		
D1. Easy to Understand	4.67	4.75	E1. Easy to Use	4.67	5.00
D2. Text	5.00	4.75	E2. Can w/o instruction	5.00	4.75
D3. Image	4.33	4.75	E3. Friendly	5.00	5.00
D4. Appeal	4.33	4.50	E4. Present	5.00	5.00
D5. Org	4.67	4.75	**Perceived Usefulness**		
Navigation			U1. Useful for Online	5.00	5.00
N1. Ease2Navi	5.00	4.75	U2. On top	4.00	4.75
N2. Button#	5.00	4.50	U3. Access	5.00	5.00
N3. Labels	5.00	4.75	U4. Contribute	4.67	4.75
			U5. Will use app	5.00	5.00

In exploring the reasons the navigation factor scored lower in Round 2 of the study, I split the data into two sets: data for iPhone users and data for Android users. The results were clear (Figure 6). The Android users rated the navigation factor lower in Round 2 (4.33) than in Round 1 (5.00), while the iPhone users rated navigation at 5.0 in both rounds.

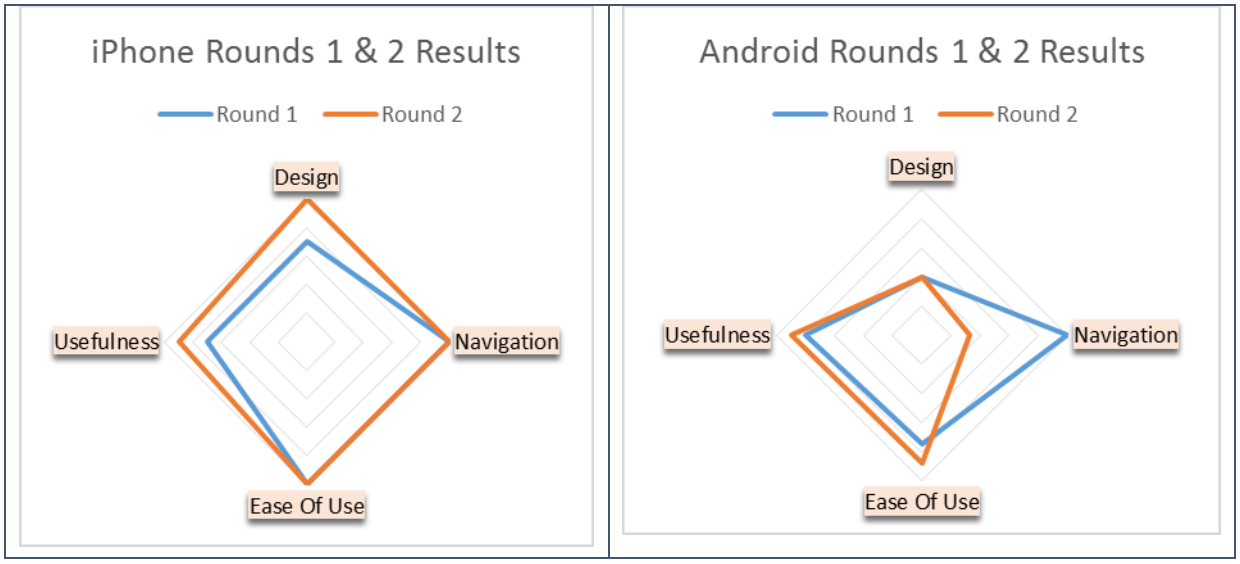


Figure 5. Rounds 1 & 2 Results by Factors and by Phone Type

Because I use an iPhone and do not own an Android, I found the design development for the Android interface challenging, and I relied on the Round 1 participant's input when I changed the tasks and instructions for Round 2. The challenge I experienced seems to have been reflected in the Round 2 results from the Android users. Round 2 required

participants to complete more tasks than Round 1. The longer time spent on the tasks may have caused more frustration among the Android users, and may have manifested in the results for the design and navigation factors. The iPhone users marked all of the post-test survey questions with the highest score (5.0) except for one question: U2. *The app keeps me on top of everything in the online course*, which they rated at 4.50. In the meantime, the average scores from the Android users were: design, 4.40; navigation, 4.33; ease of use, 4.88; and usefulness, 4.90. However, because of the small number of subjects tested, the results might be a result of individual differences.

Table 6. Post-test Results by Phone Types and Factors

Design	iPhone		Android	
	Round 1 (n = 2)	Round 2 (n = 2)	Round 1 (n = 1)	Round 2 (n = 2)
D1. Easy to Understand	5.00	5.00	4.00	4.50
D2. Text	5.00	5.00	5.00	4.50
D3. Image	4.50	5.00	4.00	4.50
D4. Appeal	4.50	5.00	4.00	4.00
D5. Org	4.50	5.00	5.00	4.50
Mean	4.70	5.00	4.40	4.40
Navigation				
N1. Ease to Navigate	5.00	5.00	5.00	4.50
N2. Button#	5.00	5.00	5.00	4.00
N3. Labels	5.00	5.00	5.00	4.50
Mean	5.00	5.00	5.00	4.33
Ease of Use				
E1. Easy to Use	5.00	5.00	4.00	5.00
E2. Can without	5.00	5.00	5.00	4.50
E3. Friendly	5.00	5.00	5.00	5.00
E4. Present	5.00	5.00	5.00	5.00
Mean	5.00	5.00	4.75	4.88
Perceived Usefulness				
U1. Useful for Online	5.00	5.00	5.00	5.00
U2. On top	4.00	4.50	4.00	5.00
U3. Access	5.00	5.00	5.00	5.00
U4. Contribute	4.50	5.00	5.00	4.50
U5. Will use app	5.00	5.00	5.00	5.00
Mean	4.75	4.90	4.80	4.90

Responses to open questions. I asked four open questions in the post-test survey: Q19. *What did you like about the app?* Q20. *Were there any features that were confusing to you?* Q21. *Do you have any suggestions to improve the app?* Q22. *Any other comments?* All comments in response to these questions can be found in Appendix E. To Q19. Students answered that they liked the convenience, ease of access, ease of navigation, and the fact that the class materials could be found in one location and accessed while they were on the go. One student wrote, “I’m constantly on the go so having one place to go for everything and having everything so organized is definitely very helpful!” In response to Q20, which asked about any confusing features, one Android user said that the instructions were “a little hard to follow,” but another student (iPhone user) said: “none

of the features were confusing, everything was streamlined well." To Q21, which asked for any suggestions for improvement, one student wrote about adding a "saving a password" feature. The course website requires a password to access it. The web browser on a computer can be set to remember the website password, but on the mobile app in the case of the iPhone, I found that the password-saving feature was not functional in the app folder and participants had to type the password every time they wanted to access the course website, which they felt to be unnecessarily repetitive. I added instructions in Round 2 on how to get around this problem. In Q22, I asked for any other comments, and the participants gave positive reviews of the app: "Everything is good and convenient to any working student or parents. They can access to anywhere." "This is a great app and I would definitely use it for my class!" "I am really excited to use this app!"

Discussion and Conclusions

The overarching research question of this project is whether a mobile app specifically developed for an online course can enhance students' e-learning experiences. As smartphone apps have begun to take over various functionalities of traditional websites, it is time to explore the transfer of online course websites to a mobile device, or at least to make course content more easily accessible from mobile devices. This topic is worth researching, considering the popularity of online courses and the demographics of the regional college where the author teaches. In conjunction with this overarching research question, the specific research questions that this study addresses concern the usability of the app built for an online course. The study looked into the student participants' perceptions of the app's design, navigation, ease of use, and usefulness.

This study assumes that a digital divide manifested in broadband access exists (Smith, 2015) among the study site's students. The West Oʻahu community includes Nanakuli, Waiana, and Makaha where higher poverty rates are prevalent. A typical monthly broadband subscription from an Internet provider in Hawaiʻi costs about $50. This may not be affordable for a lower income population. Therefore, it is likely that students may be accessing their course materials from their smartphones at home. If this assumption proves to be true, making the course content available and easy to access on a smartphone is imperative for supporting educational equity in our community. Mobile-enabled course content and course structure could help us prevent placing already disadvantaged students at a further disadvantage. In this context, this usability study is an attempt to fill the digital gap in educational opportunities.

Furthermore, this usability study is based on the premise that mobile learning is a new learning mode for both students and teachers, and needs to be explicitly addressed. Therefore, the "App for Online" website was developed as an illustrated mobile orientation unit to help students learn how to use the app for their e-learning. Easy access to and easy participation in the course on a mobile device are expected to bring about positive learning outcomes. Lastly, the use of a smartphone should enable students to make short stretches of time into productive time for learning.

Limitations of this study may lie with the participants. The study included only a small number of participants. In addition, it is possible that only students with high tech self-efficacy volunteered. If so, the results of the study may have been skewed to be more positive than they would be with the general student population. One participant (R1.01) was apparently quite tech savvy and she was keen to try new tech features. She used finger-print biometric authentication for her iPhone and was dexterous at navigating the mobile device. She was excited about the course app and the prospect of saving time by using it. Another participant (R1.03) had programming experience with Xcode. These tech savvy participants were eager to learn about the new course app.

However, one participant (R2.02) was a more mature student (43 years old). I personally asked him if he could volunteer, as I noticed that he had an Android phone, and I needed to recruit more Android users for Round 2 of the study (iPhone users were the first to volunteer). He told me that he was not tech savvy and he needed to get a new phone. His phone was an older LG phone. In completing his seven tasks, he took almost an hour and a half, and I intervened in the process from time to time. This student was not tapping into the university's wifi connection, but instead using a 3G cell connection. He had not enabled his phone to use the high-speed wifi connection available at the university (100 mbps download, 102 mbps upload). This participant's experience during the study made me think that there could be more students who may have a smartphone but have not used many of the useful functions that a mobile device could offer.

This led me to conclude that we need to deliberately and intentionally teach students what a mobile device is capable of as part of computer education, rather than leaving students to learn on their own. While some students may initiate learning on their own, other may not. Moreover, to some, a "good smartphone" may be out of reach. Smartphones and mobile devices can be expected to support higher productivity among workers and students alike. It is indispensable for today's young people or future workforce members to be able to deploy mobile devices to effectively conduct day-to-day operations. In the same way that universities have a basic computer class that is required for students, we may want to integrate learning modules on how to use a mobile device into our teaching.

As evidence for the necessity of explicitly teaching students how to use mobile devices for their learning, recall this study's finding that the student participants had sixty-six apps installed on their smartphones on average, but 9% of them at most were school-related apps. Two participants reported that they had no such apps. It may require a shift in the mindset of students and teachers to reframe the functions of smartphones from being just for communication and entertainment to being for learning. Realizing that a mobile device can be a learning tool could enable many students to have ubiquitous access to learning materials (Sharples, et., 2007), and could empower students as learners.

This study found that students embraced a simple mobile course app, the "BUSA 345 course app." The participants thought that it was easy to use and very useful for learning the subject. They all intended to use the app if it were available, and were excited about the prospect of being able to study on the go. The BUSA 345 course is conducted entirely online. A mobile app would enhance students' learning by enabling ubiquitous access to the course materials anywhere and anytime, which would be particularly valuable for

those students who have multiple life obligations, such as fulltime jobs and families, along with their studies. The app was developed on a code-free HTML5 editor that anyone can use to create a cross-platform mobile app. More studies are necessary to ascertain the effectiveness of such a mobile app for online courses. Yet developing a simple app, as shown in this study, seems to be a small investment on the teacher's part that may have high returns in better student learning outcomes. Furthermore, it is hoped that this app can be a first step toward filling a broadband digital divide among the students in our community.

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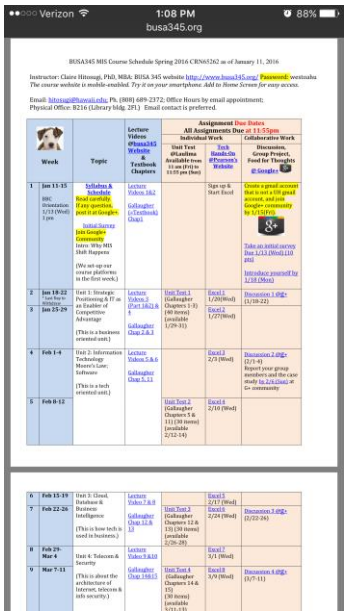
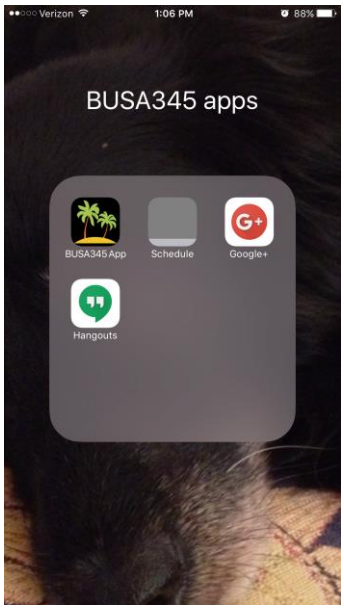
Appendix A
BUSA 345 App Interface

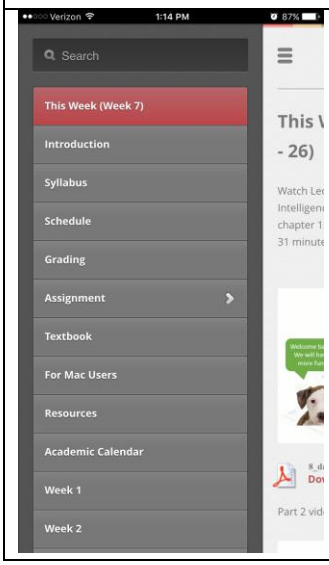
BUSA 345 Course Schedule View

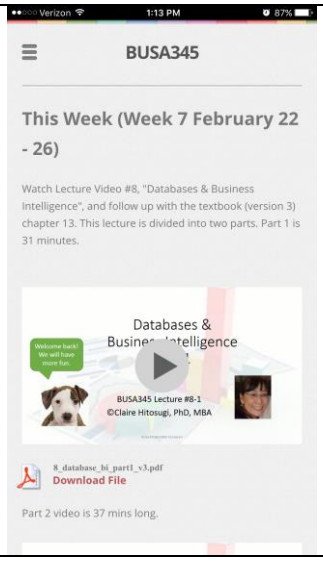


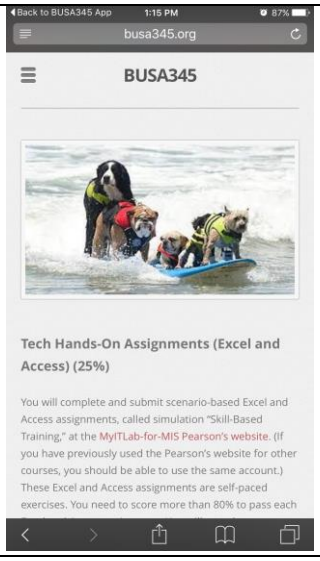
BUSA 345 Apps Folder View



BUSA 345 Website Mobile App View

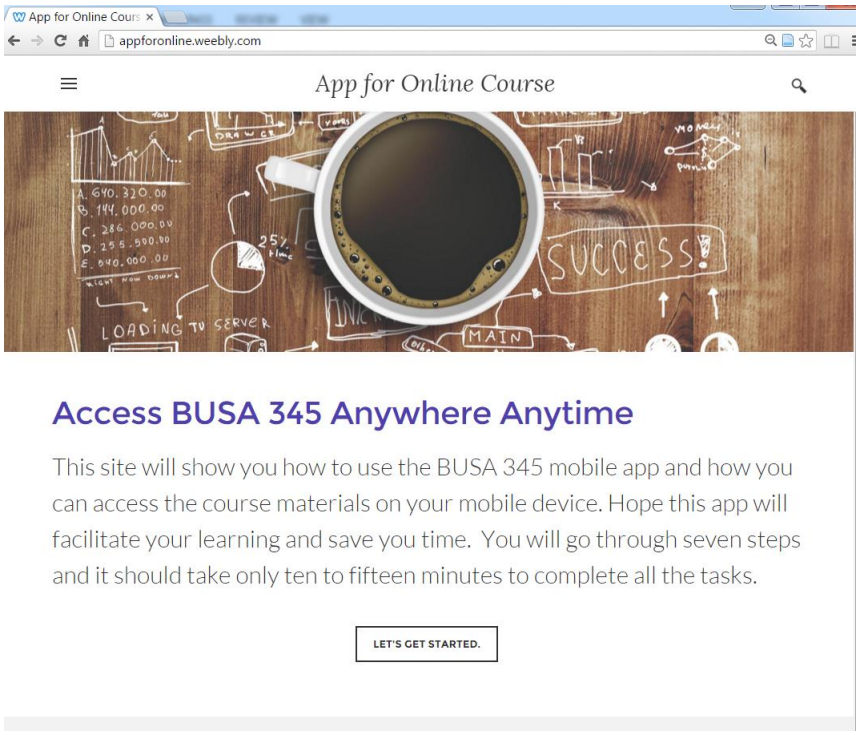




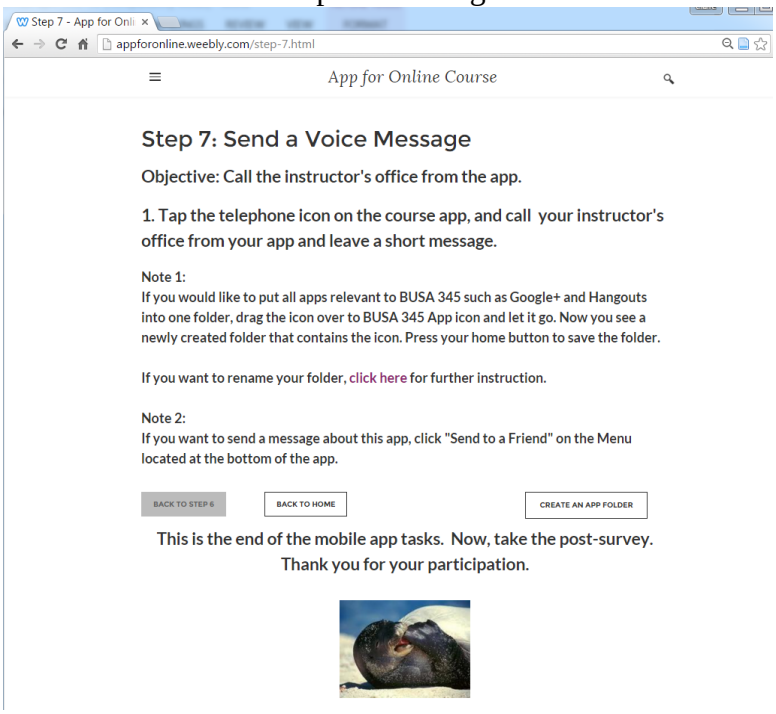


Appendix B
App for Online Course Tutorial Website
http://appforonline.weebly.com

Introductory Page



Step 7 Final Page



Appendix C
Pre-test Survey Questions

Thank you for your interest in taking part in this study. This pre-survey is designed to gather background information regarding demographics, attitudes, and technology use for the research purposes only, and is not meant to assess your individual performance. This survey should only take you 5 minutes at most to complete.

1. What is your gender? Male Female
2. What is your age?
3. What is your class standing?
Freshman
Sophomore
Junior
Senior
Other (please specify)

4. What brand of smartphone do you have? What is your model?
5. How often do you use your smart phone a day?
Very often
Often
Somewhat often
Somewhat rarely
Rarely

6. How comfortable are you with using mobile apps?
Very comfortable
Comfortable
Somewhat comfortable
Somewhat uncomfortable
Uncomfortable

7. How many apps do you have on your smart phone now? Please take the time to count now. Thanks.
8. How many apps do you regularly use on your phone?
0
1-3
4-6
7+

9. How many of the apps that you have on your smartphone can be considered "for school/college"?
0
1-3
4-6
7+
10. Do you regularly access online course content on your smart phone?
Strongly agree
Agree
No opinion or uncertain
Disagree
Strongly disagree

11. Have you ever built or helped edit an app?
Yes
No (Please skip to Question #12)

12. If so, what program or software did you build or edit?
13. What do you mainly use mobile apps for on your phone? (Please use the space below to briefly describe. List a minimum of three uses in the order you do most often to least.)
14. Do you consider yourself good at technology in general?
Strongly agree
Agree
No opinion or uncertain
Disagree
Strongly disagree

15. Do you usually learn new technology with ease?
Strongly agree
Agree
No opinion or uncertain
Disagree
Strongly disagree

Thank you for taking the time to complete the pre-survey. Now, we will test my app. Mahalo!

Appendix D
Post-test Survey Questions

Thank you so much for participating in my usability study. Below are questions I'd like for you to answer about your experience with the app. Your responses will be kept for research purposes only and is not meant to assess your individual performance. This post-survey should take no longer than 10 minutes to complete. As your responses can help me to improve the overall app, please respond in as much detail as possible. Thank you!

Strongly agree (5)
Agree (4)
No opinion or uncertain (3)
Disagree (2)
Strongly disagree (1)

Design:

D1. The app pages are easy to understand.
D2. The text on the pages are clear and easy to read.
D3. The images are interesting.
D4. The app itself is visually appealing.
D5. The organization of the site is logical and easy to follow.

Navigation:
N1. The app was easy to navigate.
N2. The number of buttons and pop-ups are reasonable.
N3. Labels for buttons or pages are clear and concise.

Ease of Use:
E1. The app is easy to use.
E2. I can use the app without instructions.
E3. The app is user-friendly.
E4. The app has a clean and simple presentation.

Usefulness:
U1. The app is useful for learning the subject.
U2. The app keeps me on top of everything in the online course.
U3. The app allows me to access online course materials anytime, anywhere.
U4: The app would positively contribute to my course grade.
U5: I would use the app if it were available to me.

Open Questions:

Q. 19 What did you like about the app?
Q. 20 Were there any features that were confusing to you?
Q. 21 Do you have any suggestions to improve the app?

Q. 22 Any other comments?

Thank you so much for taking the time to do this! Your feedback is crucial to help me improve the app.

Appendix E
Responses to Post-test Survey Open Questions

Q19. What did you like about the app?
Round 1: I enjoyed how I could access anything I needed for the class easily through my phone. It was appealing to look at and easy to navigate! Convenient and easy to use. Pretty easy to navigate. It has a simple interface and everything is clearly labeled and connects to each other. Everything. **Round 2:** The app is easy to comprehend and navigate. I really liked that everything was presented in one place. The website is also great, but I'm constantly on the go so having one place to go for everything and having everything so organized is definitely very helpful! I really like that now that I have the course schedule in iBooks, I will be able to view due dates without internet connection, and will also have links to the platform. The entire class is very user friendly, and the app definitely is the icing on the cake.

Q.20 Were there any features that were confusing to you?
Round 1: The features were not confusing to me, but it was sometimes hard to find what I needed to do on my phone (i.e. it was hard to find the "add to iBooks" part. I guess the instructions given were a little hard to follow. None of the features were confusing, everything was streamlined well. **Round 2:** NA Not really No, but I have never used Google Hangouts. I experienced difficulty hearing videos, but that was because my phone was on silent.

Q.21 Do you have any suggestions to improve the app?
Round 1: The app seems really easy to use and it is very similar to the website! I think the app is very easy to operate and it will make it so students can access information on the go. The only thing I would change would maybe add in the instructions information on directions of where things are (i.e. look for the "open in iBooks option it will appear on the top right corner of the screen). However, such instructions are not necessary to operate the app smoothly, but they would make it easier for the user.

I think it's useful enough as it already is, but maybe hyperlinking the app directly to the assignments on the other site, like MyIT would make it much more convenient. So far, I like it.
The video's did not play, and that is a problem because we need to watch the videos to be able to post discussions. Other than that, everything worked perfectly

Round 2:

NA
Not at this time
I really liked the app, my only suggestion would be to somehow include a "save password" for the site...I'm sure I could have set it up but the password was required any time I tried to enter a different part. It's not a big deal at all, though. I just know how much I like my fingerprint password.

Q.22 Any other comments?
Round 1: This is a great app and I would definitely use it for my class! Nope. All's good. I would truly use this app, I wish other classes had things like this. Kind of reinventing the way we all learn in a classroom, or making online classes much more connected despite not seeing each other in person. **Round 2:** Everything is good and convenient to any working student or parents. They can access to anywhere. I enjoyed navigating the app I am really excited to use this app! Thank you so much for taking the time to set up your class in a way to set your students up for success. :) Also, thank you for the opportunity! :) This was very exciting. :)